

Comparison of Moderate Resolution Imaging Spectroradiometer (MODIS) and Aerosol Robotic Network (AERONET) remote-sensing retrievals of aerosol fine mode fraction over ocean

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Received 5 January 2005; revised 8 April 2005; accepted 10 August 2005; published 22 November 2005.

[1] Aerosol particle size is one of the fundamental quantities needed to determine the role of aerosols in forcing climate, modifying the hydrological cycle, and affecting human health and to separate natural from man-made aerosol components. Aerosol size information can be retrieved from remote-sensing instruments including satellite sensors such as Moderate Resolution Imaging Spectroradiometer (MODIS) and ground-based radiometers such as Aerosol Robotic Network (AERONET). Both satellite and ground-based instruments measure the total column ambient aerosol characteristics. Aerosol size can be characterized by a variety of parameters. Here we compare remote-sensing retrievals of aerosol fine mode fraction over ocean. AERONET retrieves fine mode fraction using two methods: the Dubovik inversion of sky radiances and the O'Neill inversion of spectral Sun measurements. Relative to the Dubovik inversion of AERONET sky measurements, MODIS slightly overestimates fine fraction for dust-dominated aerosols and underestimates in smoke- and pollution-dominated aerosol conditions. Both MODIS and the Dubovik inversion overestimate fine fraction for dust aerosols by 0.1–0.2 relative to the O'Neill method of inverting AERONET aerosol optical depth spectra. Differences between the two AERONET methods are principally the result of the different definitions of fine and coarse mode employed in their computational methodologies. These two methods should come into better agreement as a dynamic radius cutoff for fine and coarse mode is implemented for the Dubovik inversion. MODIS overestimation in dust-dominated aerosol conditions should decrease significantly with the inclusion of a nonspherical model.

Citation: Kleidman, R. G., N. T. O'Neill, L. A. Remer, Y. J. Kaufman, T. F. Eck, D. Tanré, O. Dubovik, and B. N. Holben (2005), Comparison of Moderate Resolution Imaging Spectroradiometer (MODIS) and Aerosol Robotic Network (AERONET) remote-sensing retrievals of aerosol fine mode fraction over ocean, *J. Geophys. Res.*, 110, D22205, doi:10.1029/2005JD005760.

1. Introduction

[2] Aerosols play an important role in determining the Earth's radiation budget and in modifying clouds and precipitation [Kaufman *et al.*, 2002; Rosenfeld and Lensky, 1998]. Aerosols also adversely affect human health [Samet *et al.*, 2000]. Understanding the aerosols' physical and optical characteristics as well as their distribution patterns is necessary in order to forecast air quality and make

estimates of potential climate change [Chu *et al.*, 2003; Kaufman *et al.*, 2002].

[3] One of the important physical characteristics of aerosols is their size. Knowing particle size distribution is critical to estimating the role of aerosols in Earth's energy balance, in determining the effect the particles will have on cloud development and on human health. In addition, aerosol size is the key to using satellite remote sensing to separate natural from man-made aerosols. Anthropogenic aerosol optical thickness is dominated by fine (mode) aerosol (effective radius between 0.1 and 0.25 μm), while natural aerosols contain a substantial component of coarse (mode) aerosol (effective radius between 1 and 2.5 μm) [Kaufman *et al.*, 2001; Tanré *et al.*, 2001]. Therefore measurement of the fine aerosol fraction or the ratio of fine to coarse mode can be used to identify and quantify the extent and role in climate of anthropogenic aerosol [Kaufman *et al.*, 2002].

[4] Aerosol particle size parameters such as fraction of the fine mode or the ratio of fine to coarse mode can be measured by in situ volumetric and optical sampling mea-

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